Ethanol–Water Dew Point: Vapour → Condensate

Dew point and the liquid first condensed from an ethanol–water vapour of known strength at about 1 atm (dephlegmator, partial condenser), Wilson model.

Method: Ethanol–water VLE at about 1 atm: Wilson equation (Perry's Chemical Engineers' Handbook, 9th ed., sec. 4) with energies 399 and 933 cal/mol fitted to FireCAD ethanol–water x–y–T data at 101.325 kPa; ethanol vapour pressure Perry's 9th ed. Table 2-8; water IAPWS-IF97; Checked against Gmehling and Onken; ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Vapour strength entered as	Mole fraction	
Vapour strength	60.000	%
Pressure Model fitted at 1 atm; use 0.9–1.2 atm.	101.33	kPa

Calculated results

Parameter	Value	Unit
Vapour mole fraction	60.000	%
Dew point	81.067	°C
First condensate mole fraction	35.627	%
First condensate strength	66.400	%
Strength of the total condensate	84.931	%

Formula and method

$$y_1 = \frac{x_1 \gamma_1 p_1^s(T_d)}{P}, \quad \sum y_i = 1$$

Variables

basis	Vapour strength entered as	-
s_y	Vapour strength	-
P	Pressure	Pa
y_1	Vapour mole fraction	-
T_d	Dew point	K
x_1	First condensate mole fraction	-
q_x	First condensate strength	-
q_y	Strength of the total condensate	-
γ_1, γ_2	Activity coefficients of ethanol and water (Wilson)	-
p_1^s, p_2^s	Vapour pressures of ethanol and water	Pa

Method and standards

Dew point by bisection on the liquid composition with the bubble-point solution.

Assumptions and limits

- Wilson energies fitted at 1 atm; 0.9–1.2 atm only.
- Binary ethanol–water; congeners and dissolved solids ignored.

References

• Ethanol–water VLE at about 1 atm: Wilson equation (Perry's Chemical Engineers' Handbook, 9th ed., sec. 4) with energies 399 and 933 cal/mol fitted to FireCAD ethanol–water x–y–T data at 101.325 kPa; ethanol vapour pressure Perry's 9th ed. Table 2-8; water IAPWS-IF97

- Checked against Gmehling and Onken
- DECHEMA Chemistry Data Series vol. I/1
- as quoted in Perry's 9th ed. sec. 13 (simple batch distillation example)

Report details

Report reference	FCC-8VDH-C58T (the same inputs always give the same reference)
Generated	17 November 2026, 19:46 UTC
Calculator	Ethanol–Water Dew Point: Vapour → Condensate
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/sugar-ethanol/ethanol-distillation/ethanol-water-dew-point

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.